Space Weather Technical Forecast

Issued on Tuesday 28 January 2025 at 01:01 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of isolated M-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity has been at Moderate levels, with an isolated M2.6 flare peaking at 27/0812 UTC from over the northeast limb.

There are currently six sunspot regions on the Earth-facing disc. All regions on the visible disc are generally small and relatively simple. AR3967 in the southwest has seen some intermediate spots fading away. AR3974 in the southeast has remained steady, with an opposite polarity trailing spot now becoming visible. An as yet unnumbered region has recently developed in the northwest quadrant, currently a simple beta group. Two more new regions are beginning to emerge over the northeastern limb. The more southerly of these two regions may have been responsible for the M-flare mentioned above.

No Earth-directed CMEs have been observed in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE at L1, was at background levels, generally around 300 km/s. Density was below average initially, then became occasionally average after 27/1130 UTC. The Interplanetary Magnetic Field, Bt, was generally weak, briefly becoming moderate at times from 27/1200 UTC onwards. The north-south component, Bz, varied weakly between +/-7nT. The phi angle was either neutral or negative (towards the Sun), before becoming positive (away from the Sun) after 27/2145 UTC. Geomagnetic activity was Quiet (Kp0-2).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 was at background levels.

High energy electron flux (greater than 2MeV) at GOES16 was High, with a diurnal peak of 2530pfu observed at 27/1525 UTC. The associated 24-hour fluence persisted below the Active threshold, reaching 3.41e7 integrated pfu at 28/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate solar activity is expected with a chance of further isolated M-class flares, and a slight chance of X-class flares.

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Solar Wind / Geomagnetic Activity: A CME associated with a filament eruption around midnight on 26 Jan may give a weak glancing blow late on Day 1 (28 Jan) or early on Day 2 (29 Jan), albeit this is low confidence with most of the CME expected to miss Earth. A large coronal hole, currently in the eastern hemisphere, may become geoeffective into Day 4 (31 Jan).

Quiet to Unsettled activity (Kp0-3) is generally expected through the forecast period, with a very slight chance of Active to G1/Minor Storm (Kp4-5) intervals late Day 1 (28 Jan) or early Day 2 (29 Jan) should any glancing CME arrive. A rising risk of Active intervals then on Day 4 (31 Jan) with any connection to coronal hole high speed stream.

Energetic Particles / Solar Radiation: There is a slight chance of enhancements exceeding the S1/Minor Radiation Storm threshold, should any larger flares occur from the western hemisphere.

GOES16 high energy electron flux is likely to show a gradual decline. The corresponding 24-hour fluence is expected to remain below the Active threshold on a declining trend.

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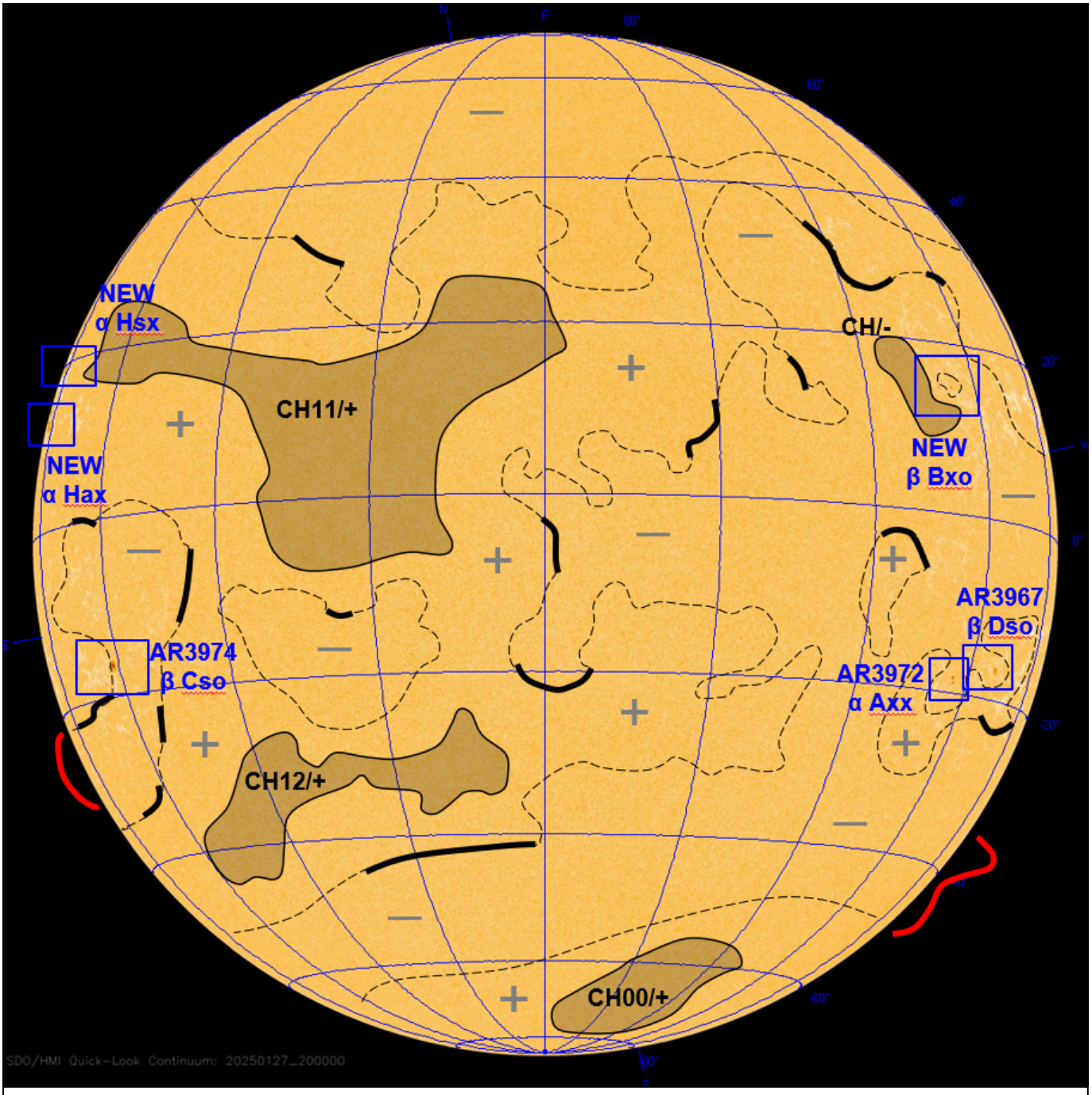
Figure 1: Solar Synoptic Map valid 27/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

No new CMEs feature in the forecast. A CME associated with a filament eruption around midnight on the 26 Jan may give a weak glancing blow late on Day 1 (28 Jan) or early on Day 2 (29 Jan), this is low confidence however with most of the CME expected to miss Earth. A small coronal hole has developed in the northwest quadrant of the disc, however any influence from this feature is likely to be limited if at all. A larger recurrent coronal hole (CH11/+), currently in the eastern hemisphere, may connect with Earth later on Day 4 (31 Jan), with winds on the previous rotation reaching Elevated levels. MOSWOC Enlil is probably too quick to connect this feature with Earth.

Quiet to Unsettled activity (Kp0-3) is generally expected through the forecast period, with a very slight chance of Active to G1/Minor Storm (Kp4-5) intervals late Day 1 (28 Jan) or early Day 2 (29 Jan) should any glancing CMEs arrive. An increasing risk of Active intervals then possible on Day 4 (31 Jan) with any connection to CH11/+.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	10	5	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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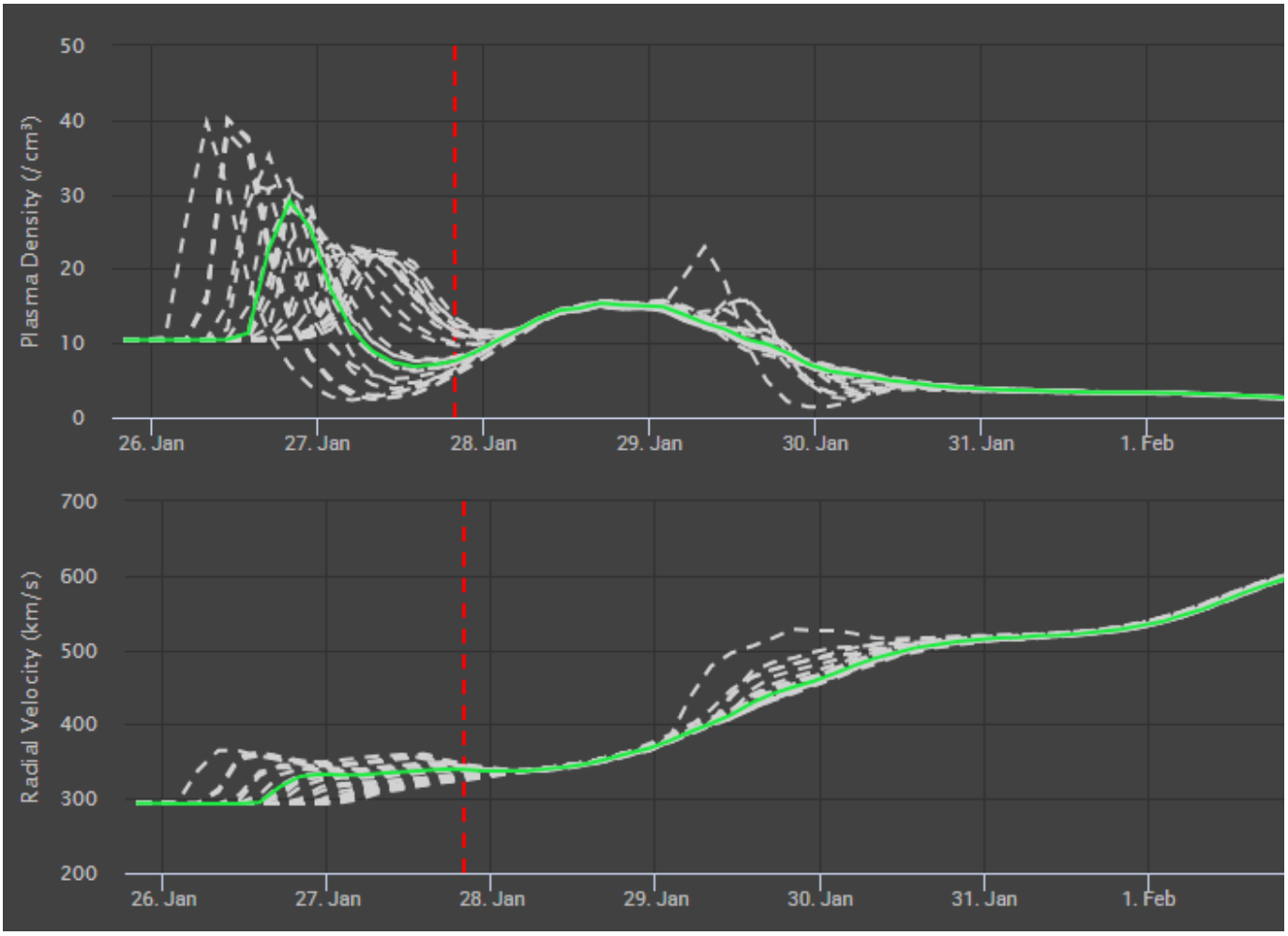
Figure 2: MOSWOC Ensemble model, showing possible CME glance on 29 Jan. Onset of fast winds later in the period likely too early.



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Radio Blackouts - X-Ray Flares

There are currently six sunspot regions on the Earth-facing disc, with AR3969 and AR3973 both fading to plage, and AR3971 rotating around the northwest limb. All remaining regions on the visible disc are generally small and relatively simple. AR3967 in the southwest has seen some intermediate spots fading away. AR3974 in the southeast has remained steady, with an opposite polarity trailing spot now becoming visible. An as yet unnumbered region has recently developed in the northwest quadrant, currently a simple beta group. Two more new regions are beginning to emerge over the northeastern limb, possibly ex-AR3947 or ex-AR3953, with analysis being updated as they rotate more into view. The more southerly of these two regions may have been responsible for an M2.6 flare at 27/0812 UTC.

Trends in the coming four-day forecast period will rely on a balance between the departures of sunspot regions over the western limb, and new regions emerging over the eastern limb. Some activity has already been observed from the northeast limb as mentioned above, and these regions are likely to reveal more complexity than currently stated over the coming days as they rotate further onto the visible disc.

Overall, the daily flare risk remains unchanged. Low to Moderate solar activity is expected with a chance of further isolated M-class flares and a slight chance of X-class flares.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	40	40	40	40
Very Active	R3-R5 (X Class)	No	5	5	5	5

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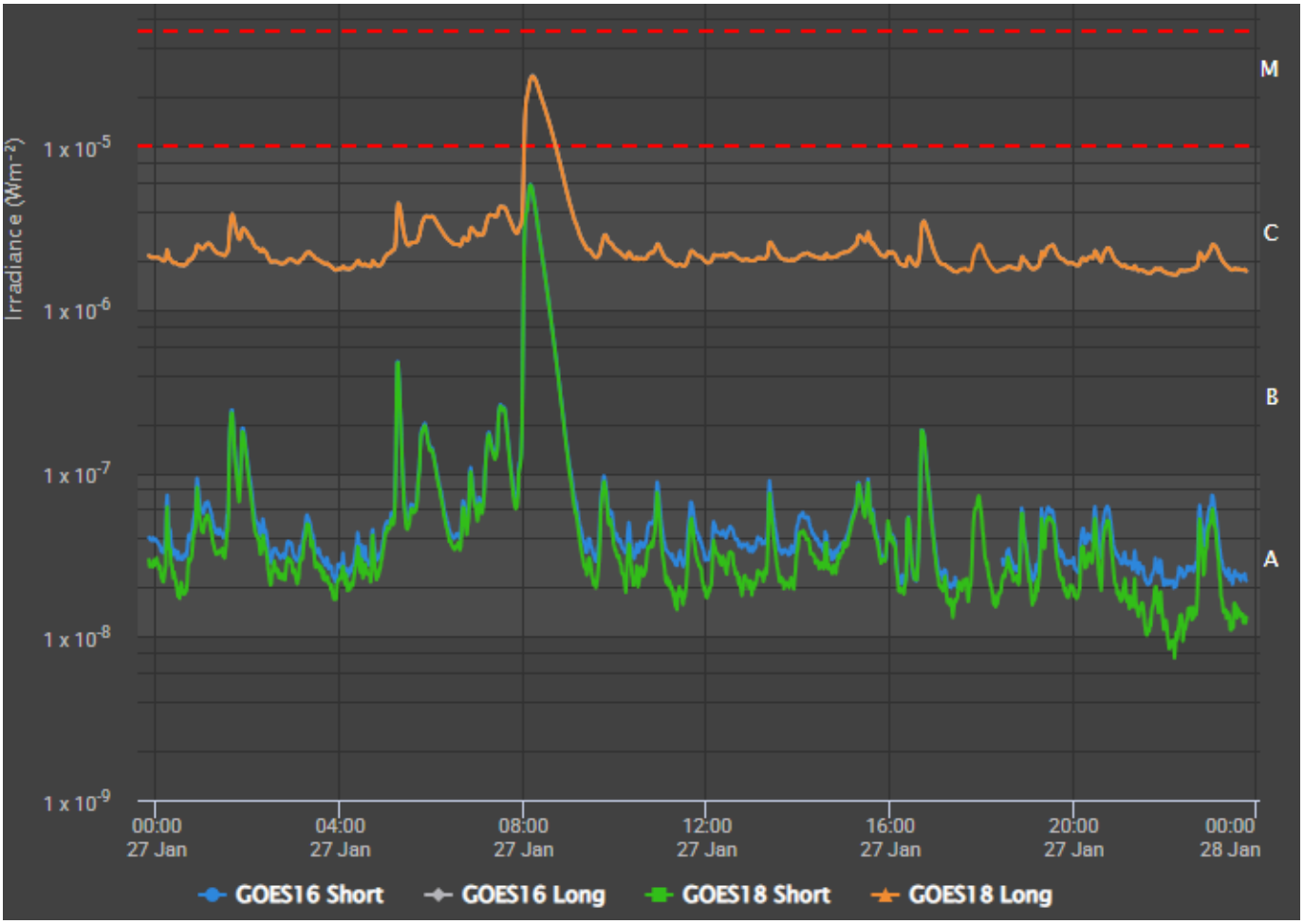
Figure 3: GOES-16 & -18 X-ray flux



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Solar Radiation Storms (High Energy Protons)

Proton flux is currently at background levels, and is most likely to stay that way. However, there is a slight chance of it rising above the S1/Minor Radiation Storm threshold in the coming days, mainly due to AR3961 which is now over the western limb. This region will have rotated well away from the west limb by Day 2 (29 Jan) so this risk declines through the period.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

High energy electron flux observed at GOES16 has been mostly at moderate levels over the last couple of days, briefly reaching high levels on 27 Jan before dropping back down to background. This all followed a connection to CH09/-, with this feature now lying comfortably over the western limb and wind speeds having returned to background levels. In the absence of further geomagnetic activity from CMEs or HSS, a decline in flux levels is forecast.

The corresponding 24-hour fluence is expected to remain below the Active threshold, with a gradual downward trend. MOSWOC REFM is felt to be giving reasonable guidance here, although clearly the forecast fluence is lower than currently observed.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: GOES-16 Electron flux

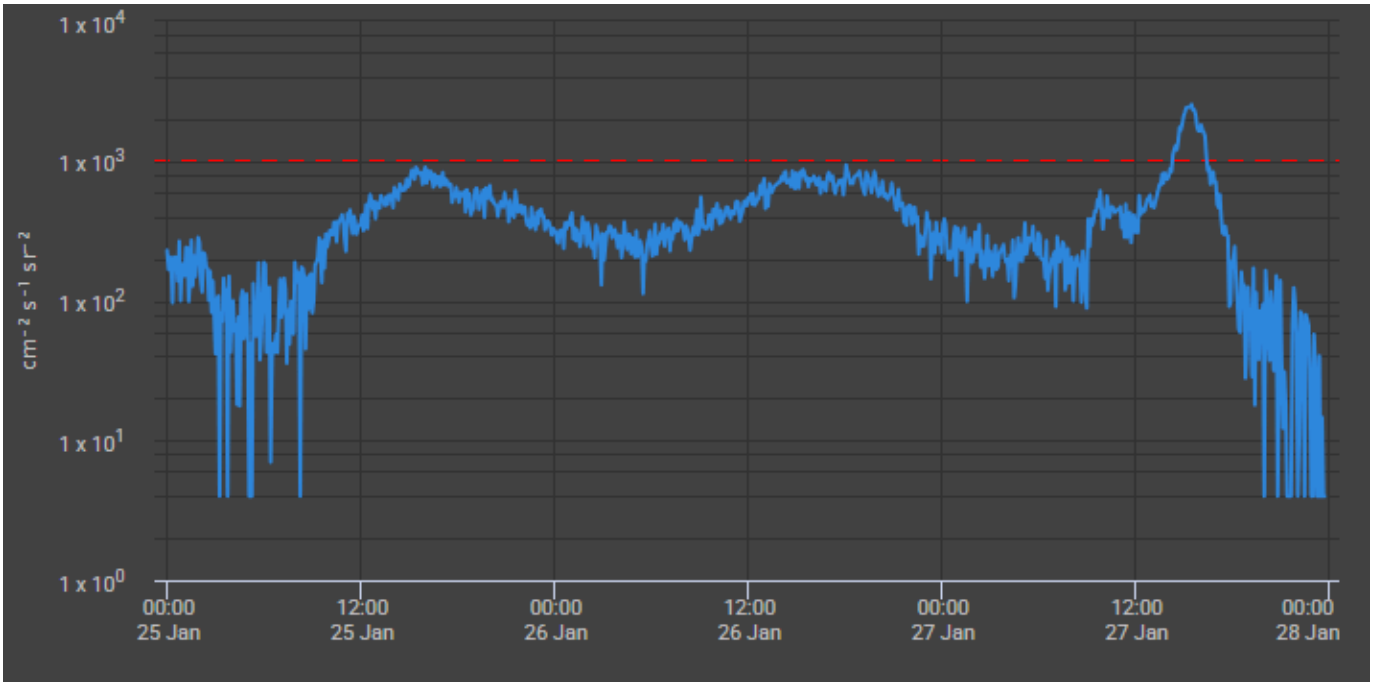

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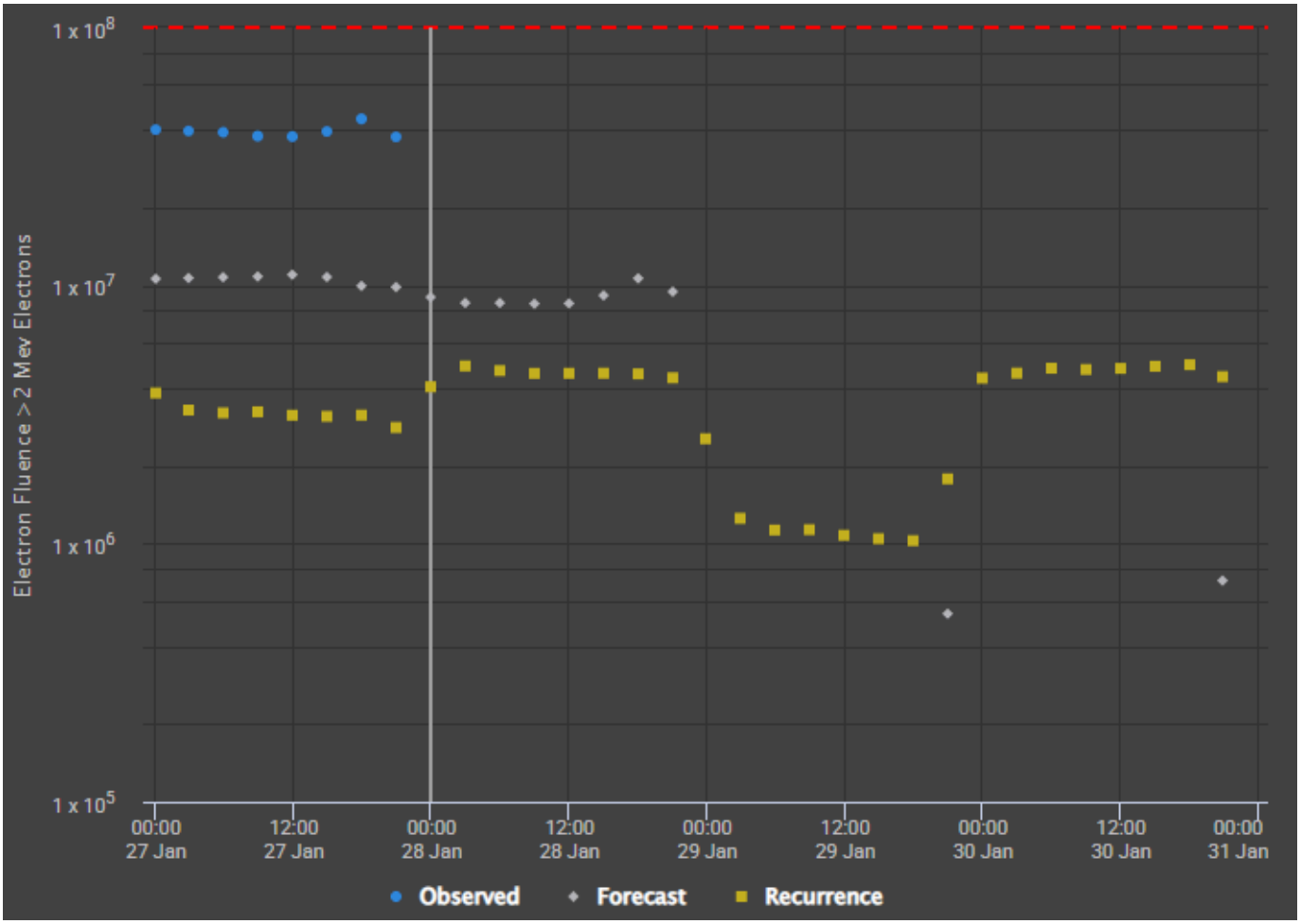
Figure 5: MOSWOC REFM



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